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The OSD, Central Test and Evaluation Program (CTEIP) is tasked to provide a coordinated process for making joint investments in defense T&E to offset the challenges presented by declining investments in test assets and increasing test requirements. Under CTEIP sponsorship, the Navy and Air Force are jointly developing three Joint Installed System Test Facility (JISTF) enhancements that are based on dynamic virtual reality simulation technology. The three enhancements are the Infrared Sensor Stimulator (IRSS), Generic Radar Target Generator, and Joint Communications Simulator. The JISTF enhancement installations will occur at the Air Combat Environment Test and Evaluation Facility, NAWCAD Patuxent River, Maryland, and the Avionics Test and Integration Complex, Air Force Flight Test Center, Edwards Air Force Base, California. These enhancements will provide each ISTF with the capability to simultaneously test multiple avionics and sensor subsystems installed on an aerospace System Under Test (e.g., manned and unmanned aircraft) in a ground test environment. The ISTF enhanced test capabilities will be used to evaluate multisensor data fusion/correlation and subsystems' interoperability for IR sensors, RADAR, GPS, and Communications and Data Link subsystems. This paper address the IRSS which will be used to stimulate installed IR/UV EO sensors undergoing integrated developmental and operational testing. The IRSS program was first briefed at AEROSENSE 1996. This paper updates the capabilities and status of IRSS over the subsequent three years. It provides an overview of the IRSS subsystems and functions with emphasis on facility integration and discussion of the IR modeling, scene generation, and scene project components.

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Joint Navy and Air Force Infrared Sensor Stimulator (IRSS) Program Installed Systems Test Facilities (ISTFs)

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ABSTRACT

The Office of the Secretary of Defense (OSD), Central Test and Evaluation Program (CTEIP) is tasked to provide a coordinated process for making joint investments in defense test & evaluation (T&E) to offset the challenges presented by declining investments in test assets and increasing test requirements. Under CTEIP sponsorship, the Navy and Air Force are jointly developing three Joint Installed System Test Facility (JISTF) enhancements that are based on dynamic virtual reality simulation technology. The three enhancements are the Infrared Sensor Stimulator (IRSS), Generic Radar Target Generator (GRTG), and Joint Communications Simulator (JCS). The JISTF enhancement installations will occur at the Air Combat Environment Test and Evaluation Facility (ACETEF), Naval Air Warfare Center, Aircraft Division (NAWC-AD), Patuxent River, MD and the Avionics Test and Integration Complex (ATIC), Air Force Flight Test Center (AFFTC), Edwards Air Force Base, CA. These enhancements will provide each ISTF with the capability to simultaneously test multiple avionics and sensor subsystems installed on an aerospace System Under Test (SUT) (e.g. manned and unmanned aircraft) in a ground test environment. The ISTF enhanced test capabilities will be used to evaluate multi-sensor data fusion/correlation and subsystems' interoperability for Infrared Sensors, RADAR, GPS, and Communications and Data Link subsystems. This paper addresses the IRSS which will be used to stimulate *installed* Infrared/Ultraviolet (IR/UV) Electro-Optic (EO) sensors undergoing integrated developmental and operational testing. The IRSS program was first briefed at AEROSENSE 1996. This paper updates the capabilities and status of IRSS over the subsequent three years. It provides an overview of the IRSS subsystems and functions with emphasis on facility integration and discussion of the IR modeling, scene generation, and scene projection components.

KEYWORDS: Installed Systems Testing, Infrared Sensors, Scene Simulation, Sensor Fusion, Interoperability, Electronic Combat Test Process.

1. INTRODUCTION

The IRSS System will be capable of satisfying installed sensor system test requirements, through dynamic stimulation of IR/UV EO sensors which are integrated with other avionics, processing software and platform sensor systems, (e.g., radar, onboard flight programs (OFP)). To be a valid test tool, the spatial, spectral and temporal components of the IRSS computer-generated synthetic scenes should be of sufficient fidelity to produce sensor responses that are indistinguishable from the tested sensor's response to "real-world" conditions. Figure 1 identifies the type sensors and general range of the spatial, spectral and temporal characteristics that can be tested using the baseline IRSS capability. The IRSS will be capable of supporting both performance characterization and integrated sensor testing.

Simultaneous with the development of IRSS requirements, the Air Force and Navy funded risk reduction studies via Air Force Small Business Innovative Research (SBIR) studies and by the Navy Project Director's use of technical support contracts with Amherst Systems, Inc. in Buffalo, NY. Several of the Air Force SBIR efforts proceeded to Phase II and now form the underlying technical basis for the acquisition of Signal Injection Subsystem (SIS) components and large area terrain IR databases. Amherst Systems was selected in January 1997, as the prime contractor for fabrication of the IRSS Scene Generation System (SGS) component and in December 1998 for development of the IRSS Signal Injection Subsystem. The last component of the IRSS system development is the Infrared Scene Projection (IRSP) subsystems. With the state of infrared scene projection technologies still in evolution, the IRSS program delayed the development of a full Scene Projection Subsystem (SPS) capability until after completion of the SGS and SIS capabilities. State-of-the-art resistor array technologies will provide an Infrared Point Source Projector (IRPSP) as an interim SPS capability. In April 1998, the SPARTA Corporation was selected as the integrator for these interim projector systems.

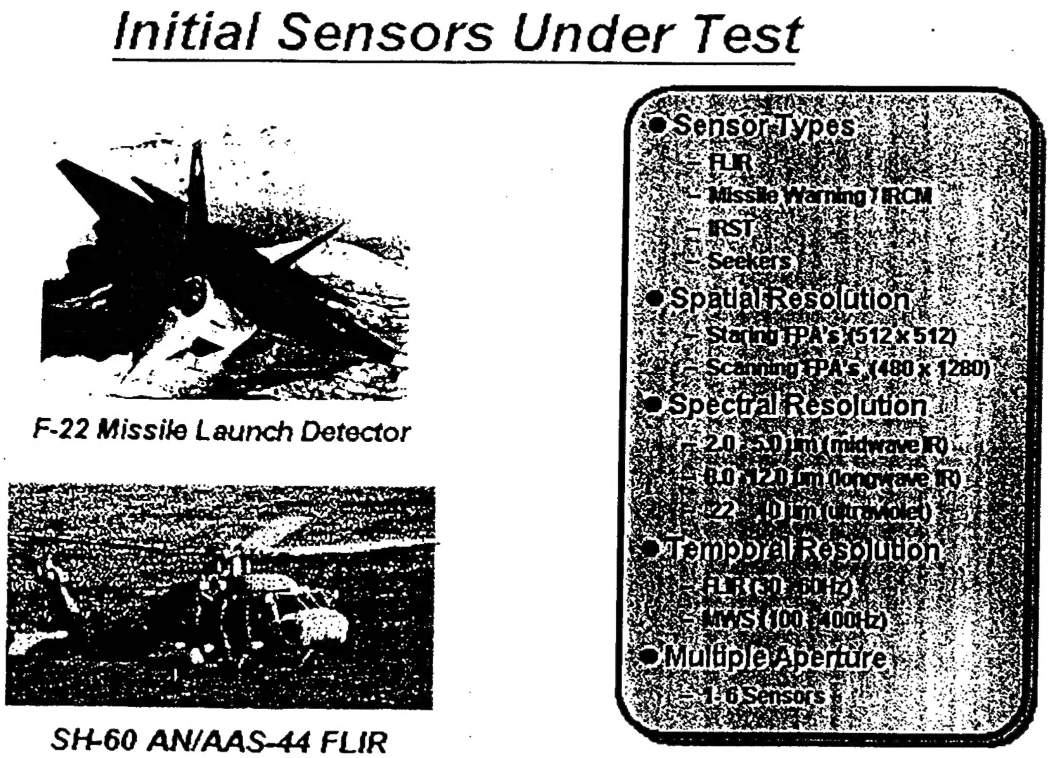


Figure 1 - IRSS Sensor Support Capability

2. IRSS SYSTEM ARCHITECTURE

The IRSS system is comprised of hardware and software distributed throughout six primary subsystems as illustrated in Figure 2. Four of the Subsystems support the scene generation/simulation component and two stimulation components suppòrt the free space projection and signal injection of the scene to the sensor under test.

The *simulation* subsystems include: the Modeling and Database Subsystem (MDBS) and Scenario Development Subsystems (SDS), which support non-real-time scene generation functions; and the Simulation Control Subsystem (SCS) and Scene Generation Subsystem (SGS), which support real-time scene generation. The two *stimulation* subsystems, the Signal Injection Subsystem (SIS) and the IR Point Source Projector (IRPSP) Subsystem provide the capability for real-time electrical signal injection into the processing electronics and/or optical projection of scenes onto the sensor's detectors. Amherst Systems Inc. (Amherst) is developing the four subsystems of the scene generation/simulation component. The SIS and IRPSP stimulation subsystems, are being developed by Amherst and SPARTA Corporation (SPARTA) respectively. A full image Scene Projection Subsystem (SPS) is planned as a future enhancement.

The current IRSS hardware design configuration consists of two Silicon Graphics Onyx2s Infinite Reality™ graphics computers with eight and twelve "R10000" processors respectively, several Octane and O2 workstations, convolution processors, pixel processors, sensor electrical interfaces, and EO/IR projection subsystems.

IR sensor detector arrays record (scanning) or detect (staring) a two dimensional projected image of a three dimensional scene. The scene generation components of the IRSS System create a two dimensional representation of the scene corresponding to the recorded or detected image for subsequent presentation to the sensor being tested. This requires careful/radiometrically accurate and rapid (real-time) computation of both the target and background signatures.

The Scenario Development System is used to define the target and background content, including non-targets, for the duration of the simulated test. The definition process uses models and databases contained in the Modeling and Database Subsystem. Once a test scenario is defined, the real-time execution of the "virtual" test is performed by the Scene Generation Subsystem under the control of the Simulation Control Subsystem.

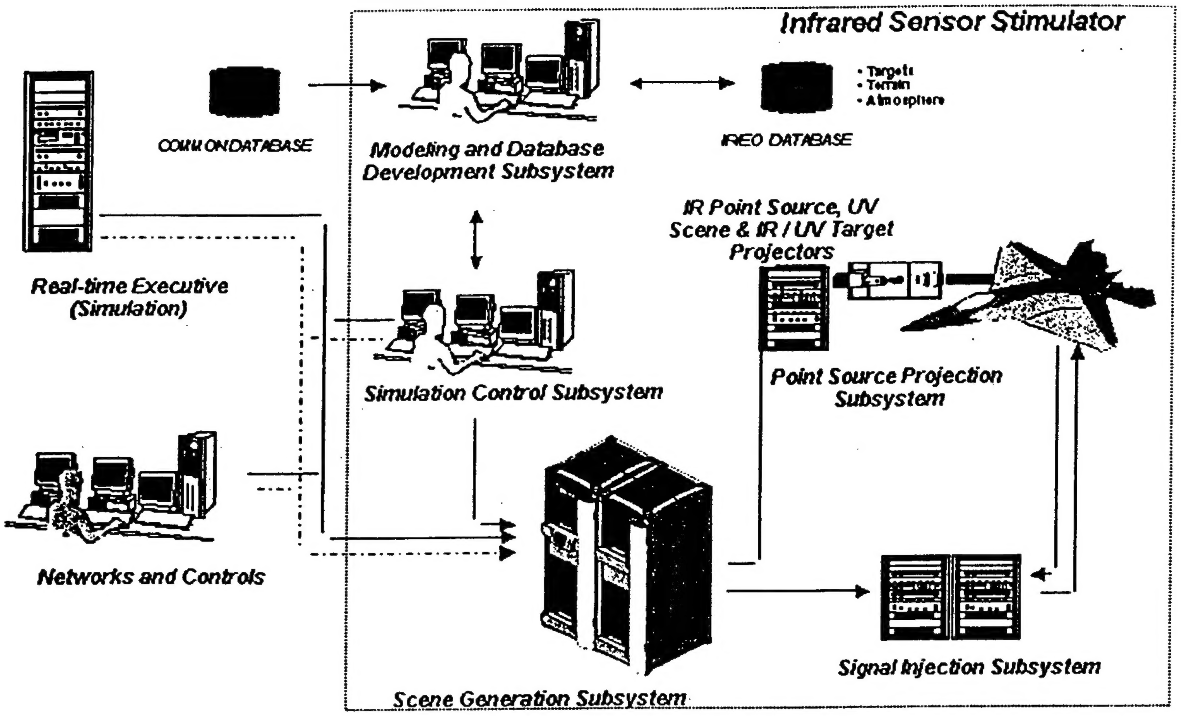


Figure 2 - IRSS System Architecture

3. SCENE GENERATION CAPABILITY

The Modeling and Database Subsystem (MDBS) capability, illustrated in Figure 3, provides the test engineer/operator with the capability to build files representing threats, real and false targets, back-grounds, and atmospheric elements off-line (i.e., in a non-real-time mode) from sources such as plume radiance models, missile trajectory models, terrain elevation data, measured and/or statistically derived clutter data, and atmospheric models. The primary output of the MDBS is the IR/EO Database, which contains the files used for subsequent scenario development and real-time simulation. The MDBS supports the import and conversion of external database elements from common terrain or target databases that use a standardized open-architecture, three-dimensional geometric file format to provide commonality with other ISTF stimulators. Extended OpenFlight™ has been selected as the "standard" for model input/output and databases. The IRSS incorporates the MultiGen™ Application Program Interface (API) as a tool to support the creation, attribution integration and execution of the models and databases. Use of the MultiGen™ also enables the import and manual attribution of other external database. Additional discussion of this subsystem is presented below.

The Scenario Development Subsystem (SDS) provides the operator/test engineer with the capability to define simulation scenarios in which a single or multi sensor equipped vehicle moves through a test area. The primary output of the SDS consists of two files, scenario and simulation, within the Scenario Database. The scenario file references scripted terrain, targets, threats, trajectories and special effects selected from the IR/EO Database. Simulation files contain a file reference to a scenario file plus customized simulation elements. These elements include an atmosphere specification, sensor specification, test platform assignment, sensor channel assignment(s), and state information such as situation display setup, visual display setup, and instrumentation setup. Additional discussion of this subsystem's functions is not provided in the paper.

The Simulation Control Subsystem (SCS) provides the operator/test engineer with the capability to control the execution of a simulation and perform fault tests on the IRSS channel hardware. Input to the fault test function includes diagnostic scripts executed by the operator to determine the operational state of the hardware. Output consists of the pass/fail status of the performed tests along with status or trace messages showing test progress. Upon execution of the IRSS application, the SCS is initialized by opening an existing or archived simulation file from the Scenario Database and setting the control-state. When external/integrated control is disabled, the IRSS operates in a stand-alone mode and the operator controls the simulation clock, the situation display, the visual display, and all instrumentation. When external control is enabled, control of the simulation clock, player positions and state, test platform interface, etc. is assumed by the ISTF Operational Control Center (OCC). The OCC may send a Load/Initialize command to the SCS that contains a scenario script specifying some or all scenario and configuration information. Additional discussion of this subsystem's functions is not provided in the paper.

Modeling Database Subsystem

An Interactive Environment for Building, Attributing, and Visualizing 3D IR / UV / EO Target, Object, Atmospheric and Terrain Models

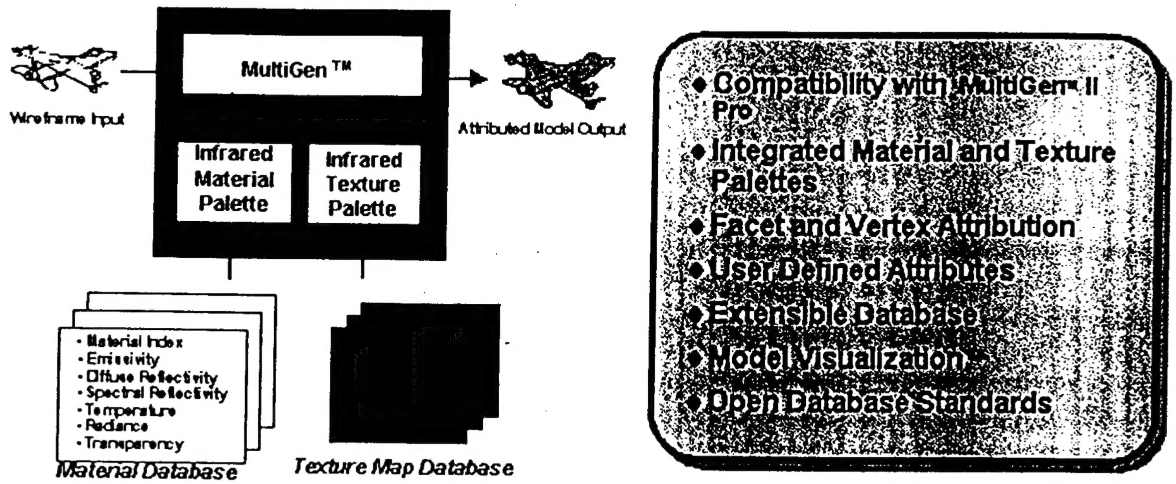


Figure 3 - MDBS Capability

The Scene Generation Subsystem (SGS) produces IR/EO scenes in real-time. The term "real-time" is relative to the frame rate of the sensor under test (e.g. 30 – 100 Hz for FLIR, 100 – 400 Hz for MWS). The SGS incorporates "first principle" algorithms for the radiometric computation of the signatures. A "virtual" test may involve stimulation of multiple sensors (up to three) requiring multiple SGS channels. Each channel stimulates a single sensor or a single aperture of a multi-aperture sensor. A sensor-specific configuration is supplied during initialization. The SGS performs both scene generation and scene rendering. During scene generation, the SGS determines the viewed scenario area, on a frame to frame basis, based on the direction of the sensor line-of-sight, and host platform position in space (e.g. altitude, heading, pitch, roll). The specified simulation file is examined to determine which polygons, representing players/targets and background elements, occur within the viewed area. The material characteristics and polygon viewing geometry are used to calculate radiometric values for polygon vertices. During scene rendering, polygons are decomposed into pixel elements and inserted into an output frame buffer resulting in a radiometric, spatial, and temporal representation of the scene as viewed by the sensor relative to its line-of-sight. This digital scene is the input from the SGS into either the SIS for conversion into an electrical signal that is injected into the sensor processing electronics or the IRPSP for optical projection into the sensor's entrance aperture. Additional discussion of this subsystem is presented below.

4. Modeling and Database Subsystem

This subsystem contains the models, tools and databases which are used to represent target and backgrounds in the test scenario. The models identified in Table 1 are used in the calculation of signatures, atmospheric conditions and target and test platform flight paths. Model selection is based upon wide use in the simulation community, identified as a government "standard", e.g. endorsement by SURVIAC or JANNAF/CPIA, or an acceptable level of validation.

To compensate for their non-real-time execution speed, some models, e.g. MODTRAN, ESAMS, TRAP, are executed off-line to create look-up tables or databases that are used during run-time scene generation. Once created, these look-up table databases become part of an EO/IR library. Whereas the IRSS System is required to respond to un-scheduled, non-scripted events including man-in-the-loop commands in the external control-state, the trajectory models within the IRSS System are only intended for scripted applications.

Model	Function	Implementation
Signatures		
SPF/SIRRM	Missile & Air Vehicle Plumes	Point source intensity only
SIRRM	Extended Plumes	Under investigation
SPIRITS	Air Vehicle Body	• 5,000 airframe facets typical • resolution → facet reduction • asynchronous, non-real-time execution via interface
PRISM	Ground Vehicles Ships (?)	• 3,000-8,000 tank facets typical • resolution → facet reduction • asynchronous, non-real-time execution via interface
thermal	Terrain Heat Transfer/Temperature	PRA (TERTEM) and DCS (THERM) one-dimensional models under evaluation
IRENE, SHIPIR	Ships & Sea Backgrounds	Under investigation
Atmospheric		
MODTRAN	IR attenuation, path radiance & solar irradiance	Real-time lookup tables from off-line execution
OSIC	UV background/scattering	Real-time lookup tables from off-line execution
cloud	Background (not 3D)	Under investigation
obscurant	Background (not 3D)	Under investigation
[illegible]		
Trajectory		
BLUEMAX	Test & adversary air vehicle flight paths	Off-line execution → scripted trajectory
ESAMS	S/A missile flyout	Off-line execution → scripted trajectory
TRAP	A/A missile flyout	Off-line execution → scripted trajectory

Table 1 - 3rd Party Model Utilization

Not all of the models are restricted to off-line execution. The IRSS System contains a flexible, non-synchronized interface that enables 3rd party or other external models to provide asynchronous updates to executing scenario files. The frequency of the updates will depend on model performance within the allocated resources and the fidelity required for the target, and/or background, signatures. This mode of operation is planned for some of the target signature models such as SPIRITS, PRISM and a ship model. Thermoanalytics included modifications in PRISM Version 3.3 to permit start-stop-start execution in response to the IRSS requirement for asynchronous "real-time" operation.

Terrain definitions are fully attributed, faceted surface descriptions derived from Digital Terrain Elevation Data (DTED) augmented with cultural details such as roads, bridges, and buildings. The DTED data is used to create polygonal wire-frames representing terrain contour or shape. Terrain attributions include material properties, textures, and temperature specifications. Background detail, i.e. texture, at the sensor pixel level is represented by texture maps overlaid on larger terrain polygons. The modeling of sea backgrounds, as characterized by sea state, is presently under investigation.

Two contractors, DCS Technologies and Photon Research Associates have created the initial IRSS terrain databases identified in Table 2. Both contractors use similar techniques starting with Multi-Spectral Scanner (MSS) satellite imagery (30 meter resolution) augmented, in some cases, with higher resolution panchromatic imagery and DTED Level I data of the test scenario area. The MSS imagery is segmented into multiple terrain material types using statistical clustering algorithms resulting in texture maps. The PRA approach generates Wavelength-Independent Texture (WIT) Maps One primary and several secondary materials (that vary with location) represent the terrain. The WIT Map includes the proportional mix of these materials versus location or "mixture map." By assigning the appropriate material properties, the same WIT map can be used for sensors with different spectral bands.

Location	Source	Geographic Coverage	Mass Storage Required	Resolution (meters)
China Lake	DCS Technologies	77 x 82 km	250 MB	10
Edwards High-Speed Corridor*	Photon Research	220 x 546 km	TBD	2.5 to 25
South West Asia	DCS Technologies	≈ 770 km sq	20 GB	10
White Sands MR	Amherst Systems	14 km sq		90 elevation 5 texture

Table 2 - Planned Terrain Databases (* Includes Edwards (Main Base @ 2.5 m) and China Lake Ranges)

5. Scene Generation Subsystem

As noted earlier, the SGS performs both scene generation and scene rendering. In the scene generation process, the SGS determines the targets and background within the sensor field-of-view. This significantly limits consideration of the target and background description files in the scenario. In addition, the processing pipeline attempts to maximize throughput by culling the polygons in these descriptions, or eliminating those not visible to the sensor, before it begins its radiometric calculations. The radiometric calculation algorithms are based in part on those previously incorporated into the Amherst Systems' Real-Time Infrared Scene Simulation (RISS) product. The SGS will operate on two Silicon Graphics' Onyx2™ Infinite Reality™ Graphics computers with eight and twelve "R10000" processors. The processing power of these computers can be expanded or upgraded by adding or replacing node card assemblies each containing 2 CPUs. Figure 4 illustrates the planned CPU allocation of the current configurations to the SCS and SGS functions during "virtual" test execution.

During the subsequent rendering process, the selected polygons are decomposed into pixels and inserted into an output frame buffer. The SGS will contain two rendering systems; the SGI Infinite Reality™ system and a custom rendering system being built by Amherst Systems a part of the IRSS scene generation component development. The capabilities of the two rendering engines are identified in Figure 5 below. Infinite Reality™ limitations on maximum frame rate and computational accuracy are the principal reasons for incorporating the custom rendering engine into the IRSS. The improved capabilities are required in order to test present and emerging high-frame-rate missile warning sensors.

The rendered apparent scenes include atmospheric effects along the optical path from the scene to the sensor, and are input to the sensor presentation subsystems that are briefly described in the next section. Figures 9 and 10 below present examples of apparent scenes generated by the current SGS, and related operator situation displays.

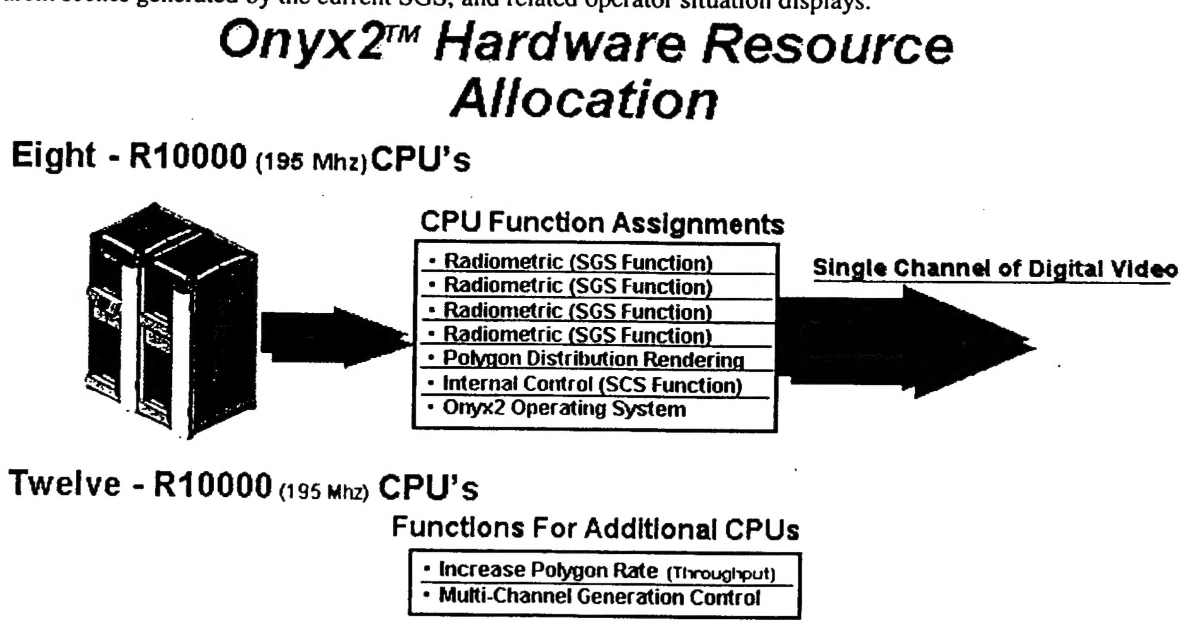


Figure 4 - Hardware Resource Allocation

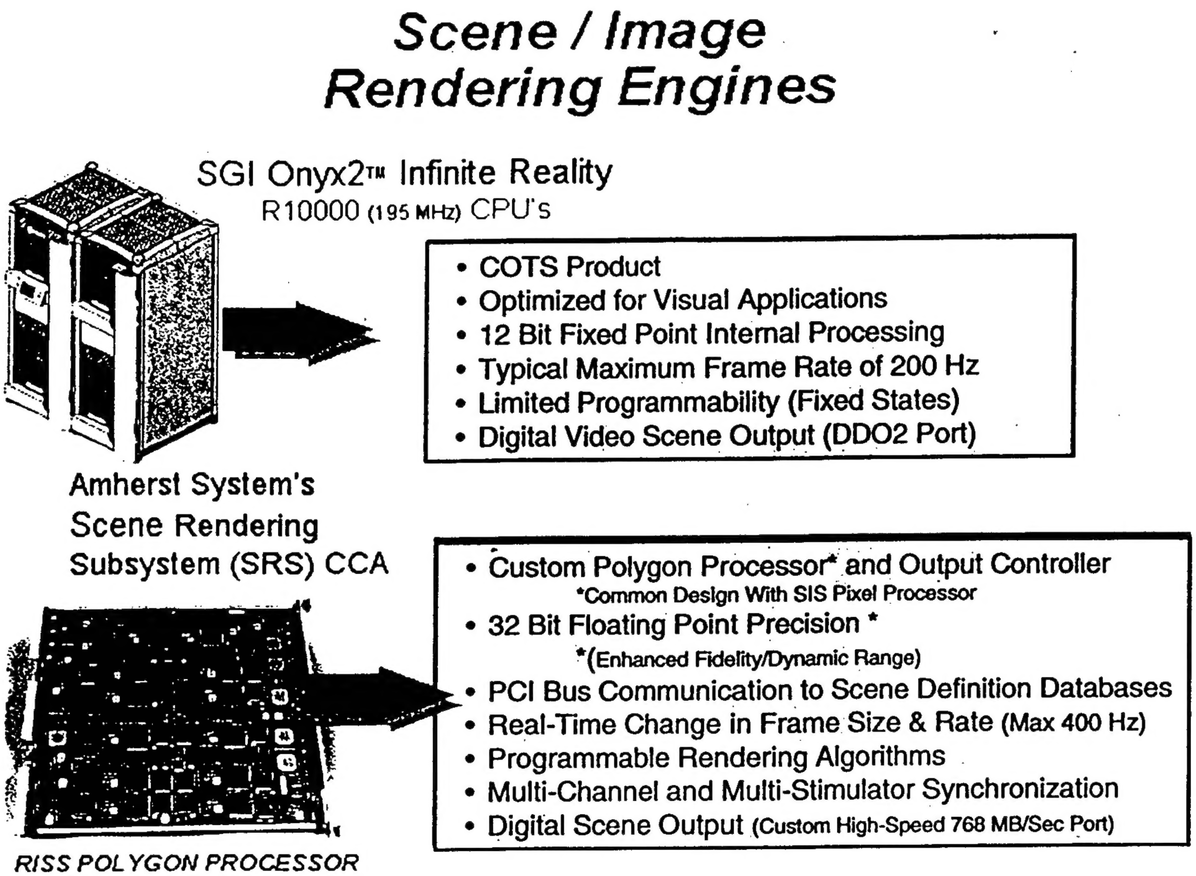


Figure 5 - SGS Rendering Engines

6. SENSOR PRESENTATION METHODS

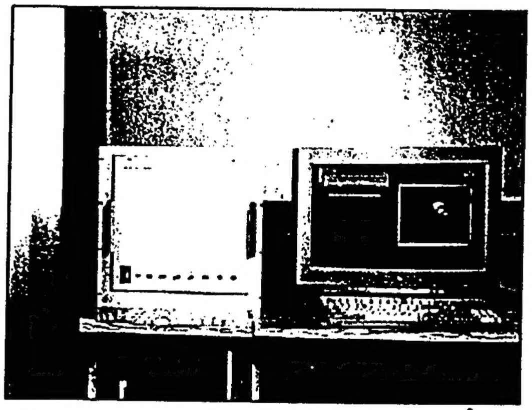
The baseline IRSS will include two transducer/stimulator subsystems that perform the function of presenting the SGS generated apparent scene to the sensor under test. There are two types of transducers; electrical signal injection and optical projection (equivalent to a free space RF emitter).

The Signal Injection Subsystem (SIS) accepts digital scenes produced by the SGS and creates an electrical digital or analog signal that is injected into the sensor image/signal processing chain. This subsystem is presently under development and manufacture by Amherst Systems as a product of the innovative research on Air Force SBIR contracts for a Universal Programmable Interface (UPI). The capabilities of the SIS are identified in Figure 6.

As part of the signal creation function, the SIS must modify the scene to represent the effects of by-passed sensor components/phenomenology, prior to the injection point, convert the modified image to a properly conditioned electrical signal, and provide the electrical connection to the sensor. The scene modification is accomplished by two custom processing components within the SIS, a convolution processor and a pixel processor. These SIS components utilizes digital signal processor (DSP) arrays; high-speed Xilinx programmable gate array chips for the convolution processor, and Motorola 266 MHz Power PC 740 chips for the pixel processor. The latter hardware assembly is common to the polygon processor in the previously discussed Amherst Systems' rendering engine. The Sensor Interface Module (SIM), which is unique to each sensor, provides generation and conditioning of the electrical signal and its physical connection to the sensor. This assembly is a plug-in module that provides the capability for the SIS to be easily configured for different sensors.

An additional function of the SIS, is the processing (e.g. I/O handling) of sensor control signals and, if necessary, emulating their functionality. These functions may require one or more electrical connections to the sensor or other test platform avionics systems.

A Programmable Interface for Direct Signal Injection Stimulation of IR / UV / EO Sensor Systems



SIS Chassis and Operator Workstation

- **Provides Real-Time Emulation of by-passed components of IR / UV / EO sensors**
- **Provides a sensor specific electrical interface for injection**
- **Synchronous High Frame Rate Processing**
- **Precision Convolution/Pixel Processing for MTF and per pixel effects emulation**
- **Configurable Frame Rate, Frame Size, and Emulation Parameters**
- **Stimulates Sensors or Drives Projection Devices**

Figure 6 - Signal Injection Subsystem

The IR Point Source Projector (IRPSP) is another transducer/stimulator sub-subsystem that presents a generated scene to the sensor. The primary function of the IRPSP is to accept digital input scenes produced by the SGS and to generate equivalent output scenes, in the form of in-band electro-optical/infrared energy, for projection into the entrance aperture of the UUT. The format of the scene input to the IRPSP from the SGS will be Silicon Graphics, Inc. (SGI) Direct Digital Output for the Onyx2 (DDO2), also known as the Onyx2 Digital Video Port (DVP). The IRPSP will also be capable of accepting scene input from the SIS in a DDO2 format. Setup and control of the IRPSP will be managed by the SC via the SGS to IRPSP interface. The IRPSP will consist of seven primary subsystems as illustrated in Figure 7. These subsystems are the Control Electronics Subsystem (CES), Environment Control Subsystem (ECS), Infrared Emitter Subsystem (IRES), Mounting Platform Subsystem (MPS), Non-Uniformity Correction Subsystem (NUCS), Projection Optics Subsystem (POS), and Software Control Subsystem (SCS).

These IRPSP subsystems are currently under design, acquisition and integration by SPARTA. The most critical IRPSP subsystem is the IRES. The IRES converts the high resolution, digital scenes into in-band infrared radiation at frame rates which match, or exceed, that of the UUT sensor. Several stringent requirements are levied on the IRES as the result of the installed systems test environment. These requirements include: compact size to minimize interference with RF stimulation; minimal weight for mounting to SUT (aircraft) surfaces; low noise, long length input interface for remote operation in/out of a large RF anechoic chamber; and minimal equipment operating within the anechoic chamber operation. To satisfy these IRES requirements, the IRSS program has selected the Multispectral Infrared Animation Generation Equipment (MIRAGE) Digital Emitter Engine (DEE) from Santa Barbara Infrared, Inc. (SBIR) to provide the IRES capability. The SBIR MIRAGE DEE is a new state-of-the-art 512x512 pixel thermal resistive array device which utilizes on-chip digital to analog converters, snapshot frame update, and several other innovative designs to provide a low noise, compact, light weight IRES subsystem which is ideal for the installed systems test environment. The POS, unique for each type UUT (e.g., FLIR, MWS), will transform the IRES output into a collimated beam of IR scene energy to fill the entrance aperture of the UUT sensor.

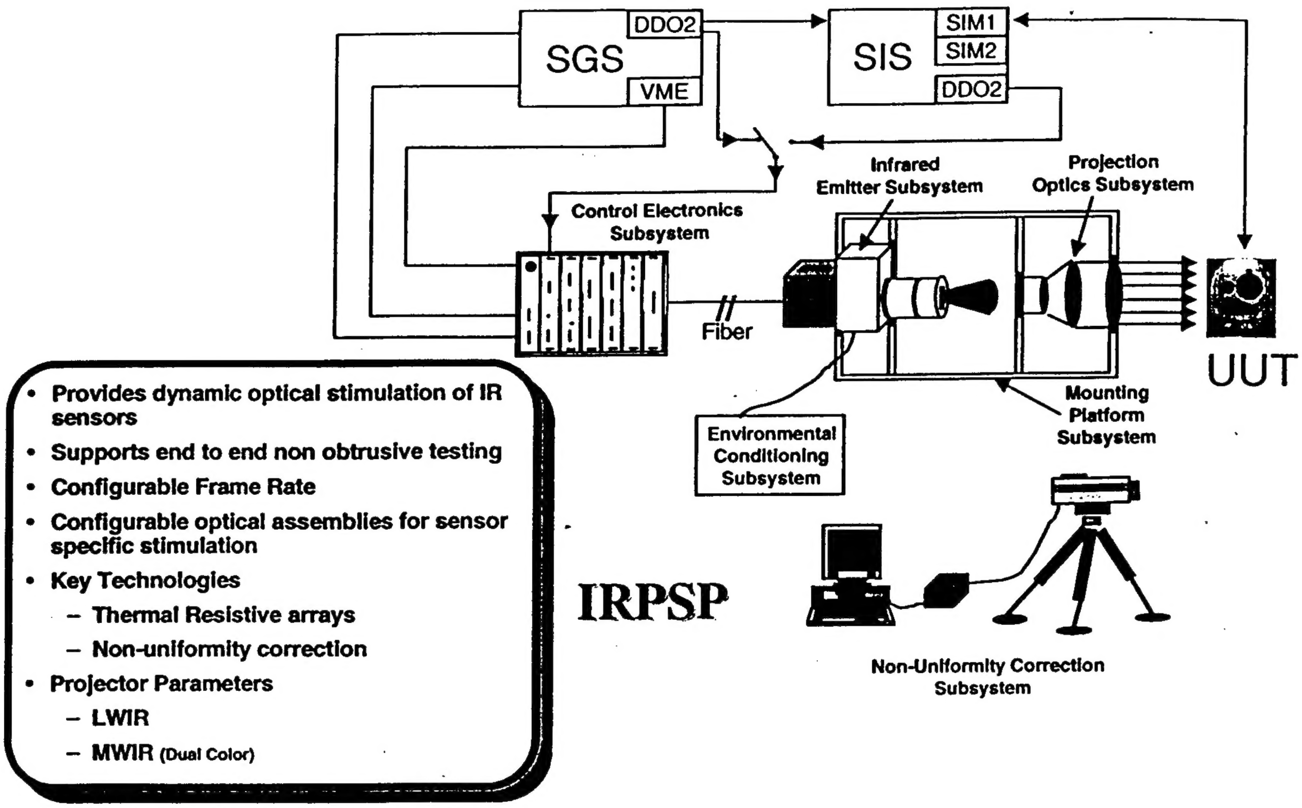


Figure 7 - IR Point Source Projector

7. IRSS DEVELOPMENT PROCESS

The IRSS development process, illustrated in Figure 8, emphasizes the dependence of requirements on the test objectives and sensor capability. The Users Group consists of Navy and Air Force Test Engineers and representatives of the IRSS sub-system developers, and meets periodically to review and refine the sensor test objectives, and their impact on IRSS requirements. In addition, the users have exercised the intermediate scene generation component providing feedback to the developers for improvements that are incorporated into the next release. This activity has the additional benefit of providing incremental hands-on training to the users thus minimizing the time before a customer's test can be supported.

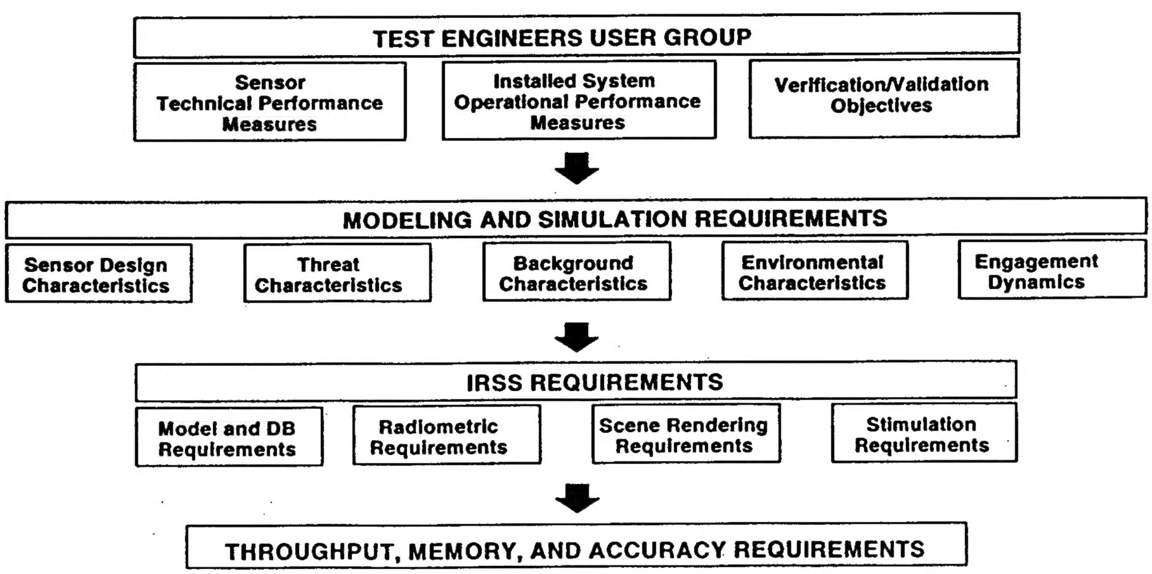


Figure 8 - IRSS Systems Engineering Methodology

The IRSS will have the capability to test a variety of IR/UV sensors. However, the *manufacture* of the initial operating system requires priorities be established among the types of sensors so that the specification target and background requirements receive proper emphasis within the resources and time available. Table 3 contains the priorities established to satisfy this objective.

No	Sensor Type	Priority	Target Type	Background Importance	Background Type
1	Missile Launch Detector (MLD) / Missile Warning Receiver (MWR)	High	Missile Plumes (Core & Exterior)	Moderate	Terrain or Sky
2	Forward Looking Infrared (FLIR) - Navigating	High	N/A	High	Terrain/Cultural
3	Forward Looking Infrared (FLIR) – Targeting	High	Ground Targets Airborne Targets	High Moderate	Terrain/Cultural Sky
4	Infrared Search & Track (IRST)	Moderate	Distant Point Source Targets	Air-To-Air: Moderate Air-To-Ground: High	Sky Terrain/Cultural
5	Missile Seeker	Low	Aircraft Plumes Aircraft Other	Low to Moderate	Sky/Cloud Clutter or Terrain/Cultural
6	Common Missile Warning System (CMWS)	Growth	Missile Plumes (Core & Exterior)	Low	Atmospheric
7	Multi-Color and Hyperspectral Sensors	Growth	TBD	TBD	TBD

Table 3 - Sensor Stimulation Priorities

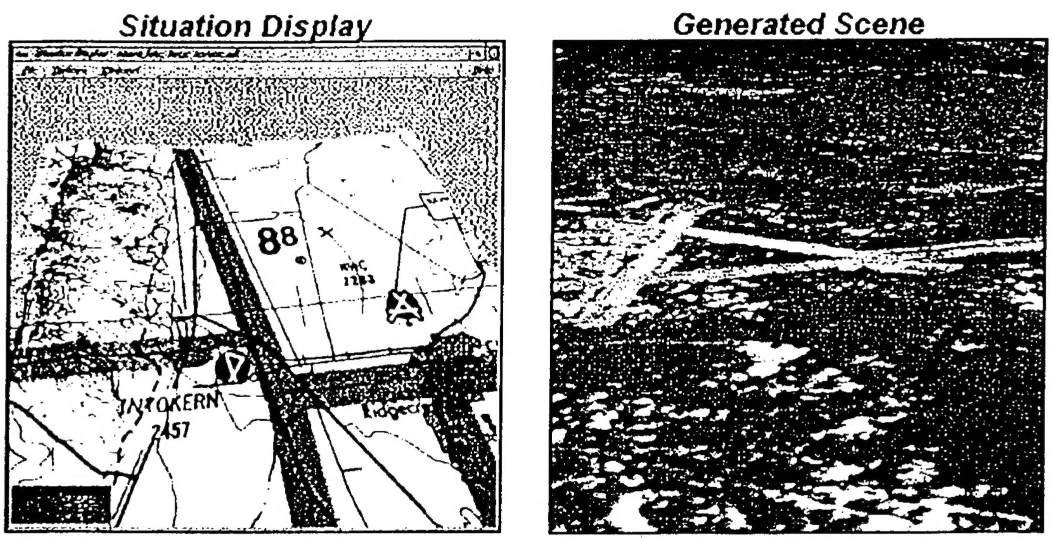
Table 4 describes the objective and status of the development of each of the current IRSS components. The Amherst scene generation component development has been implemented as an iterative functional build (spiral) process. In this process additional functional capability is incrementally developed and incorporated with stable baselines. This approach enables the measurement of progress at the end of each spiral including the delivery, demonstration and evaluation of in-process software. As a result of the spiral development process, scene generation capability has been delivered and tested by both the Navy and the Air Force. SPARTA is currently developing two IRPSPs, one for the Navy for testing FLIRs and a second system for the Air Force for testing MLDs. Figures 9 and 10 below present examples of apparent scenes generated by the current SGS, and related operator situation displays.

Table 4 - Scene Generation Spiral Development Objective Descriptions

IRSS Component	OBJECTIVE	STATUS	COMPLETION DATE
Amherst Build 1	• Convert Amherst Systems RISS scene definition software to SGI Onyx2 Platform	Complete	January 1998
Amherst Build 2	• Single Channel Scene Generation (Onyx2/Infinite Reality Rendering)	Complete	July 1998
Amherst Build 3	• Single Channel Scene Generation (Amherst's SRS Rendering) • 3rd Party Terrain and Target Database Support	Completed	February 1999
Amherst Build 4	• Multi-Channel Scene Generation (Onyx2/Infinite Reality Rendering) • Multi-Channel, Multi-Rendering Engine Scene Generation • 3rd Party Model Integration	In-Progress	July 1999
Amherst Build 5	• Integration ,Delivery and Acceptance Testing • Documentation & On-site Training •		February 2000
Amherst UPI Phase II	• Demonstrate Universal Programmable Interface • Demonstrate(UPI) H/W for F-22 MLD & AAS-44 FLIR Sensors	In-Progress	August 1999
Amherst SIS Build 4u	• Operator Interface Software Development • Hardware Requirements Development/Design • Sensor Interface Module Development/Design & SGS Integration	In-Progress	June 1999
Amherst	• Operator Interface Software Development	Planned	February 2000

IRSS Component	OBJECTIVE	STATUS	COMPLETION DATE
SIS Build 5u	• F-22 MLD & AAS-44 FLIR Sensors Interface Modules • NTSC/PAL Interface & Video Display Modules • SGS Integration		
Amherst SIS Build 6u	• Fiber Optic Interface & SRS Interface Modules • UUT Instrumentation Interfaces • SIS Programming/Production & PSP Integration	Planned	August 2000
Amherst SIS Build 7u	• Installation, Demonstration & System Level Testing • Operator Training	Planned	September 2000
SPARTA IRPSP 1	• Design, Fabrication, Integration, Test, Installation, IRSS Facility Integration, and Verification of IRPSP 1 at the Navy ACETEF	In-Progress (post CDR)	November 1999
SPARTA IRPSP 2	• Design, Fabrication, Integration, Test, Installation, IRSS Facility Integration, and Verification of IRPSP 2 at the AF ATIC	In-Progress (pre CDR	February 2000

Table 4 - Scene Generation Spiral Development Objective Descriptions (Continued)



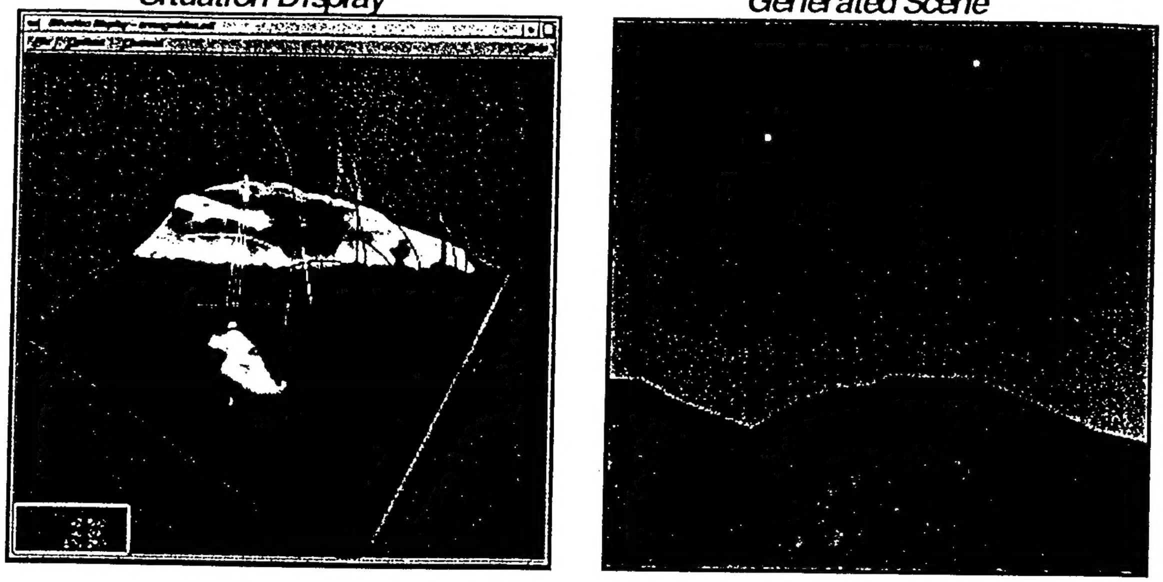
Terrain DB: China Lake
Atmosphere: Tropical Standard, 3km Vis.
Altitude: 1900 m (AGL)
Sensor: Typical FLIR

Spectral Band: 8-12 um
FOV: 20 x 20 deg.
IFOV (Pixel Size) 0.7 mrad
Images Size: 512x512 Frame Rate: 30 Hz

Figure 9 – Example Of Rendered Scene (1 of 2)

Background/Threats with Infinite Reality Rendering

Situation Display *Generated Scene*



Terrain DB: White Sands Missile Range
Atmosphere: Tropical Standard, 3km Vis.
Altitude: 290 m (AGL)
Sensor: Typical MWS Threat: Typical SAM

Spectral Band: 8-12 um
FOV: 45 x 45 deg.
IFOV (Pixel Size) 3.1 mrad
Images Size: 250x250 Frame Rate: 30 Hz

Figure 10 – Example Of Rendered Scene (2 of 2)

8. CONCLUSIONS

The IRSS is a cost-effective system that provides flexible, re-configurable, reproducible and repeatable full test environments for evaluating IR/EO sensor systems during the concept, research, development, prototype, and test and evaluation phases. It is a valid / verifiable test and evaluation risk reduction tool that optimizes utilization of costly range testing when employed as an integrated ISTF element. The IRSS sensor modeling capability contributes to the systems, and sensor, development, and EMD performance effectiveness evaluation.

The scene generation component has successfully completed its Spiral 3 development and the software has been delivered to the Navy and Air Force for evaluation. The signal injection component has completed PDR, and the infrared point source projection component has completed the critical design review for the first system and is nearing the critical design review for the second system. Final ACETEF and ATIC IRSS integration is scheduled for 1st quarter Government Fiscal Year (GFY) 2000. The system's Fully Operational Capability (FOC) completion is scheduled for the fourth quarter of GFY 2000.